

AFRL-VA-WP-TM-2006-3199

**REACTIVE CONFORMAL INLET
TECHNOLOGY ENHANCEMENT**



Angela Scribben

Melissa Withrow

Aerospace Vehicle Integration and Demonstration Branch (AFRL/VAAI)

Aeronautical Sciences Division

Air Vehicles Directorate

Air Force Materiel Command, Air Force Research Laboratory

Wright-Patterson Air Force Base, OH 45433-7542

FEBRUARY 2006

Interim Report for 01 March 2003 – 25 February 2006

Approved for public release; distribution is unlimited.

STINFO COPY

AIR VEHICLES DIRECTORATE

AIR FORCE MATERIEL COMMAND

AIR FORCE RESEARCH LABORATORY

WRIGHT-PATTERSON AIR FORCE BASE, OH 45433-7542

NOTICE AND SIGNATURE PAGE

Using Government drawings, specifications, or other data included in this document for any purpose other than Government procurement does not in any way obligate the U.S. Government. The fact that the Government formulated or supplied the drawings, specifications, or other data does not license the holder or any other person or corporation; or convey any rights or permission to manufacture, use, or sell any patented invention that may relate to them.

This report was cleared for public release by the Air Force Research Laboratory Wright Site (AFRL/WS) Public Affairs Office and is available to the general public, including foreign nationals.

Copies may be obtained from the Defense Technical Information Center (DTIC) (<http://www.dtic.mil>).

AFRL-VA-WP-TR-2006-3199 HAS BEEN REVIEWED AND IS APPROVED FOR PUBLICATION IN ACCORDANCE WITH ASSIGNED DISTRIBUTION STATEMENT.

*//Signature//

ANGELA SCRIBBEN, Ph.D.
Work Unit Manager

//Signature//

FRANK WITZEMAN
Chief, Aerospace Vehicle Integration and
Demonstration Branch

//Signature//

MICHAEL J. STANEK, Ph.D.
Technical Advisor
Aeronautical Sciences Division

This report is published in the interest of scientific and technical information exchange, and its publication does not constitute the Government's approval or disapproval of its ideas or findings.

*Disseminated copies will show “//signature//” stamped or typed above the signature blocks.

REPORT DOCUMENTATION PAGE					Form Approved OMB No. 0704-0188	
<p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>						
1. REPORT DATE (DD-MM-YY) February 2006		2. REPORT TYPE Interim		3. DATES COVERED (From - To) 03/01/2003 – 02/25/2006		
4. TITLE AND SUBTITLE REACTIVE CONFORMAL INLET TECHNOLOGY ENHANCEMENT				5a. CONTRACT NUMBER In-house		
				5b. GRANT NUMBER		
				5c. PROGRAM ELEMENT NUMBER 0602201		
6. AUTHOR(S) Angela Scribber Melissa Withrow				5d. PROJECT NUMBER A0A2		
				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER 0C		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Aerospace Vehicle Integration and Demonstration Branch (AFRL/VAAI) Aeronautical Sciences Division Air Vehicles Directorate Air Force Materiel Command, Air Force Research Laboratory Wright-Patterson Air Force Base, OH 45433-7542				8. PERFORMING ORGANIZATION REPORT NUMBER AFRL-VA-WP-TM-2006-3199		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Vehicles Directorate Air Force Research Laboratory Air Force Materiel Command Wright-Patterson Air Force Base, OH 45433-7542				10. SPONSORING/MONITORING AGENCY ACRONYM(S) AFRL-VA-WP		
				11. SPONSORING/MONITORING AGENCY REPORT NUMBER(S) AFRL-VA-WP-TM-2006-3199		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.						
13. SUPPLEMENTARY NOTES Report contains color. PAO Case Number: AFRL/WS 06-0578, 27 Feb 2006.						
14. ABSTRACT As part of its Reactive Conformal Inlet Technology Enhancement (RECITE) program, AFRL is examining conformal inlet technology. Because they are flush to an air vehicle's fuselage, conformal engine air inlets cause less drag than other inlet designs. AFRL recently investigated a conformal inlet and two active flow control slot variations. Test results showed that the smaller flow control slot performed as desired and was most effective at lower wind tunnel Mach numbers and at higher active flow control mass flow rates. AFRL engineers will incorporate these valuable data into future RECITE inlet designs that require smaller amounts of active flow control air.						
15. SUBJECT TERMS conformal inlet, flow control, distortion						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT: SAR	18. NUMBER OF PAGES 8	19a. NAME OF RESPONSIBLE PERSON (Monitor) Angela Scribber 19b. TELEPHONE NUMBER (Include Area Code) N/A	
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified				

Reactive Conformal Inlet Technology Enhancement

As part of its Reactive Conformal Inlet Technology Enhancement (RECITE) program, AFRL is examining conformal inlet technology. Because they are flush to an air vehicle's fuselage, conformal engine air inlets cause less drag than other inlet designs. AFRL is examining ways to take full advantage of these benefits while minimizing a common drawback of conformal inlets, airflow distortion that negatively affects engine performance.

AFRL recently investigated a conformal inlet and two active flow control slot variations. The first variation was 20% of the inlet height, and the second variation was 5% of the inlet height. Both variations were designed to improve engine air quality by ejecting air over the length of the recessed ramp leading down to the inlet. In addition, engineers also evaluated the effectiveness of the ramp's sidewalls, which were shaped to passively influence air quality.

Engineers evaluated the effectiveness of these active and passive flow control variations during a wind tunnel test involving various tunnel Mach numbers, inlet mass flow rates, and flow control mass flow rates. Test results showed that the smaller flow control slot performed as desired and was most effective at lower wind tunnel Mach numbers and at higher active flow control mass flow rates. While the ramp walls did not significantly influence air quality, they proved a good starting point for further research. AFRL engineers will work with the Air Force Office of Scientific Research and the Air Force Institute of Technology to incorporate these valuable data into future RECITE inlet designs that require smaller amounts of active flow control air and that have improved passive flow control methods.

An ideal air vehicle engine inlet would transform incoming air's kinetic energy into high pressure air with no distortion. The closer an inlet is to ideal, the better the engine's performance. Submerged inlets have many advantages, but they traditionally cause varying levels of air flow non-uniformity, or distortion. The RECITE program is examining ways to eliminate this distortion.

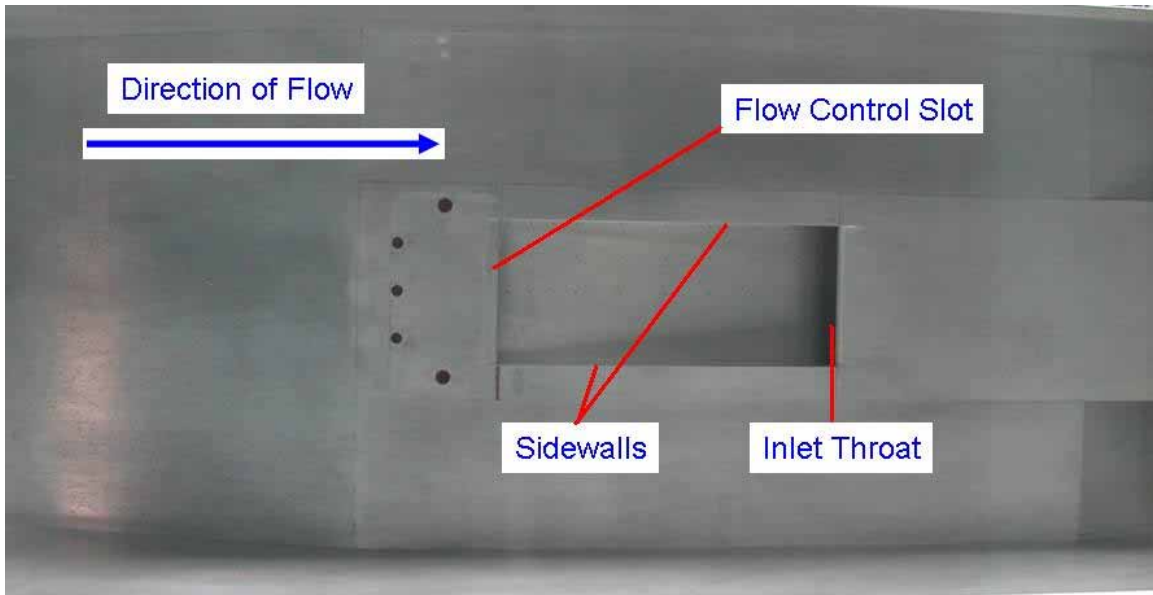


Figure 1: View of a conformal engine air inlet